

On some mathematical issues about the Sterile Insect Technique against fruit fly.

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The Sterile Insect Technique (SIT) is an autocidal method to control vector of diseases and crop pest, like fruit flies. It consists of releasing males sterilized by ionization, in a targeted area, that will mate with the wild females, resulting in a reduce, eventually a local elimination, of the wild population. While conceptually very simple, SIT is challenging to set-up, at an industrial scale.

In this talk, I focus on the impact of residual fertility [1] and double-mating on the SIT efficacy against fruit fly [2]. There is a balance to find between competition, sterilization level and residual fertility. The lower the irradiation the higher the residual fertility. In addition, multiple mating enhances the fitness of wild fruit fly. In this talk, we consider single and double-mated females. Thus, in our model, we distinguish females mated with fertile(sterile) and then sterile(fertile) males, and also females mated once or twice with wild males only.

We derive an upper bound for the residual fertility related to the parameters of single- and double-mated females. We show that when the residual fertility is small enough, there exists a release threshold above which local elimination is possible.

We illustrate our results with several simulations and show that, in some cases, re-mating may be beneficial for SIT [2]. We discuss the results in terms of real application within the framework of the project AttracTIS (funded by Ecophyto II) against the oriental fruit fly in La Réunion.

References

[1] M.S. Aronna, and Y. Dumont, On Nonlinear Pest/Vector Control via the Sterile Insect Technique: Impact of Residual Fertility. *Bulletin of Mathematical Biology*, 82: 110, 2020.

[2] Y. Dumont and C.F. Oliva, On the Impact of Re-Mating and Residual Fertility on the Sterile Insect Technique Efficacy: case study with the Medfly, *Ceratitis Capitata*, bioRxiv 2023.08.17.552275: 1-38, 2023.